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Gas Purging Device for Metallurgical Melting Pots

DESCRIPTION

The invention pertains to a gas purging device for metallurgical melting vessels. Numerous variations of gas purging devices as well as corresponding gas purging elements, particularly gas purging plugs, have been known and used for many years.

Discrete gas purging plugs can be realized with so-called directional or non-directional porosity. "Directional porosity" is achieved, for example, with channels that extend in the flushing element. "Non-directional porosity" can be achieved with a porous refractory material that has corresponding gas permeability.

Gas flushing devices can be installed into a refractory lining of a metallurgical melting vessel that forms a wall or the bottom of the vessel. However, they may also be realized in the bottom or a wall in-situ, for example, as described in EP 0 560 834 B1.

Gas flushing elements primarily serve for conducting gas. However, a gas flushing device of this type may also conduct gas/solid mixtures in certain instances.

The gases used may be inert gases, for example, when flushing ladles. However, it is also known to flush with oxygen, for example, in electric furnaces.

All gas flushing/purging devices are subjected to significant wear, particularly a chemical/corrosive attack. This is the reason why these gas purging devices need to be replaced regularly.

The left part of Figure 1 shows a conventional gas purging device. A so-called gas purging lance L is guided into the bottom region H of an electric furnace from outside, wherein said lance is held on the outer casing A of the vessel with the aid of washers B and mounted by means of a flange. Subsequently, a well nozzle S is placed over the lance L and a mass is filled between the well nozzle and the lance. The well nozzle S is subsequently walled in with bricks M and the bottom H is then lined with a furnace mass.

Once the gas purging device is worn out (indicated with a broken line in Figure 1), the entire purging device needs to be cleared. This leads to the situation illustrated in the left part of Figure 2. A new gas flushing device is subsequently installed as described above.

This method is very time-consuming and nearly the entire hearth mass of the bottom needs to be cleared, particularly up to the outer casing A.

Consequently, it is an object of the invention to develop a gas purging device that can be replaced faster and cheaper when it is worn out.

The invention proposes to separate the parts of the gas purging device that are subject to particular wear, i.e., the parts of the gas flushing device that are situated adjacent to the molten metal or the parts situated at the gas outlet end, from the parts arranged upstream thereof, i.e., in the direction of the gas inlet end.

When an exchange is required, individual parts of the gas purging device may remain and only the actually worn zones or worn parts are replaced.

According to another aspect, the actual flushing element is realized in a monolithic mass in the section that is situated adjacent to the wall of the melting vessel. This mass simplifies the alignment of the flushing element during the installation of the flusher. This mass can also be cleared and replaced more easily when the flushing device is torn down. The mass may be arranged, in turn, in a permanent receptacle that is not exchanged when the flusher (purging element) is replaced.

According to its most general embodiment, the invention pertains to a gas purging device for metallurgical melting vessels with the following characteristics:

-a gas purging brick is arranged in an upper cylindrical receptacle with its end on the gas outlet side and in a lower cylindrical receptacle with its adjacent section, and

-an annular space provided at least between the lower receptacle and the gas purging brick is filled with a mass, wherein
-the gas purging brick, the receptacles and the mass are made of a refractory ceramic material.

In this context, the term "cylindrical" merely refers to a body that is open on opposite sections and serves for accommodating another body, wherein this term does not imply any other geometric restrictions.

The lower receptacle is not subjected to wear in the normal operating state and can be enclosed with refractory bricks or a refractory mass (hearth mass) that also remains as a permanent lining when a replacement is required. Its serves for receiving a refractory ceramic mass, for example, a ramming mass, which simultaneously serves for adjusting the purging element (gas purging brick) when it is aligned in the lower receptacle and embedded in the mass. The upper cylindrical receptacle is situated adjacent to and practically forms an extension of the lower receptacle (referred to the flow direction of a gas or the direction toward the molten metal). This upper receptacle may have, for example, a circular inside cross section and encloses the purging device in a more or less direct fashion such that it forms a mechanical guide as well as a protection against chemical attacks.

The gas purging element may be arranged in the upper receptacle (i.e., on the "hot side") flush or with slight clearance. It

may be fixed in the upper receptacle by means of an adhesive or mortar.
The gas purging brick usually extends over the entire length (height) of the upper and the lower receptacle. It may also protrude the upper receptacle by a short distance (when mounted). The gas connection and, if applicable, a gas distribution chamber for distributing gas to individual channels or pores are situated on the other end.

The flusher (gas purging element) may have a circular cross section. However, gas flushing elements in the shape of truncated cones or cuboid geometries may also be utilized. When using a cuboid purging element, the upper receptacle accordingly has a rectangular cross section.

In this context, the term "cylindrical receptacle" should be understood in the form of an enclosure for a certain length of the gas purging element regardless of its inside cross section. The outside cross section may have an arbitrary shape.

At least one receptacle may be realized in the form of a pressed part. Pressed enclosure parts for the flushing element are particularly tight and consequently wear-resistant.

The purging element itself can be realized with directed or non-directed porosity. Purging elements with directed porosity are used, in particular, when purging electric furnaces with oxygen. This can be achieved by realizing the purging element with

several tubular channels that extend in the axial direction and consist, for example, of small metal or ceramic tubes. The purging element may be equipped with an additional lance (separate gas supply for purging element and lance) or consist merely of a lance lined with refractory material.

The length of the upper receptacle is determined in dependence on the respective application and the expected wear, namely because only the upper receptacle should be subsequently replaced.

According to one embodiment, the upper receptacle is at least as long as the lower receptacle. However, the upper receptacle may be up to four-times as long as the lower receptacle referred to the axial direction of the flushing element, i.e., in the flow direction of the gas. For example, the upper receptacle is two-times to three-times as long as the lower receptacle.

The upper receptacle may have a cross-sectional shape that makes it possible to directly place the upper receptacle on the lower receptacle. However, the upper receptacle may also have a wall thickness that corresponds to the wall thickness of the refractory mass introduced between the flushing element and the lower receptacle as discussed below in the description of the figures.

It usually suffices to realize the upper receptacle with an outside cross section that is smaller than the outside cross section of the lower receptacle. This means that the gas

purging device has a stepped cross section as shown in the right part of Figures 1, 2. However, it would also be conceivable to realize embodiments, in which the upper receptacle ends at a certain distance in front of the lower receptacle or protrudes into the lower receptacle.

The described gas purging device can be installed into the bottom or a wall of a metallurgical melting vessel. The term "metallurgical melting vessel" includes all crucibles for melting metal and for treating molten metal, respectively. The gas purging device consequently is also suitable for installation into the hearth bottom of an electric furnace, for example, an electric arc furnace.

Other characteristics of the invention are disclosed in the dependent claims as well as the remaining application documents. This includes the multi-part design of one or both receptacles.

One embodiment of the invention is described below with reference to the figures that respectively show a schematic section through the embodiment in the right part of Figures 1, 2.

The gas purging device comprises a total of four parts. A lower receptacle 10 is initially inserted during the lining process. This receptacle is a pressed, refractory enclosure of annular shape. Subsequently, a purging brick 12 with directed porosity (channels 20) is inserted via the outer wall A through an opening 14 from below (from outside),

and its section 12u is centered in the lower receptacle 10 as well as the region situated thereunder with the aid of a ramming mass. The gas outlet end 12o of the purging element 12 protrudes the lower receptacle 10 and the mass 16, respectively. An upper receptacle 18 that is also realized cylindrically analogous to the lower receptacle 10 is then placed over the upper section 12o of the gas purging element, wherein the upper receptacle has an inside cross section that corresponds to the outside cross section of the gas purging element 12. The upper receptacle 18 is aligned with the annular channel, filled with the mass 16, between the lower receptacle 10 and the purging element 12. The upper receptacle 18 is twice as long as the lower receptacle 10. The hearth mass H is ultimately introduced and the hearth bottom is formed.

In an alternative variation of the embodiment shown, the region underneath the lower receptacle 10 may also be equipped with mounting elements B analogous to the state of the art, for example, washers (as illustrated in the left part of Figures 1, 2) in order to fix the purging elements 12 on the outer wall A of the melting vessel.

The time required for lining the gas purging device shown in Figures 1, 2 is approximately one hour.

The time required for a lining process in accordance with the state of the art that is illustrated in the left part of Figures 1, 2 is approximately 2.5 hours. Another advantage of the gas flushing device according to the invention can be seen in the fact that the lower receptacle 10 can remain when

a replacement is required (Figure 2). In addition, the zones of the hearth mass H that are situated adjacent to the outer wall A can be largely preserved such that the required quantity of new hearth mass is reduced.